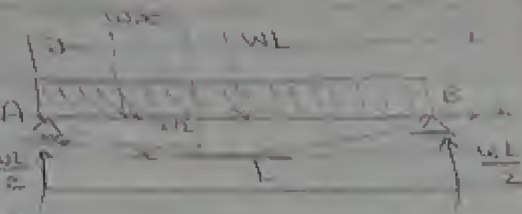
Subject: Lec. Design 5 Date: 8/12/2015

Ex 5 :-

الحمل ... الكلي
$w \times L$



$$M_x = \frac{wL}{2} x - w \cdot x \cdot x/2$$
$$= wLx/2 - wx^2/2 \qquad 0 < x < L$$

$$\frac{d^2y}{dx^2} = \frac{1}{EI}\left[\frac{wL}{2} x - \frac{wx^2}{2}\right]$$

double integration

$$EI \cdot \frac{dy}{dx} = \frac{wL}{2} \cdot \frac{x^2}{2} - \frac{w}{2} \cdot \frac{x^3}{3} + C_1$$

$$EI \cdot y = \frac{wL}{12} x^3 - \frac{w}{24} x^4 + C_1 x + C_2$$

B.C at $x = 0$ $y = 0$
$\therefore C_2 = \text{zero}$ #

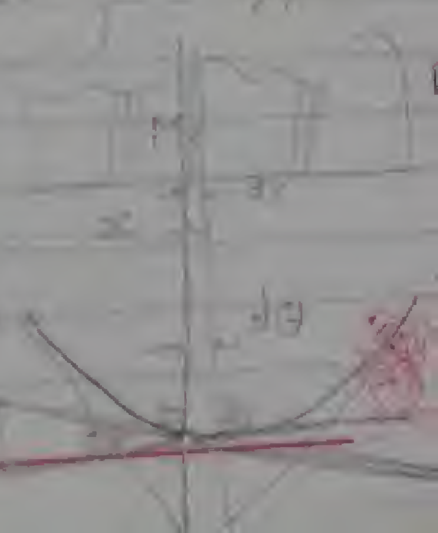
at $x = \frac{L}{2}$, $\frac{dy}{dx} = 0$

$$C_1 = -\frac{wL^3}{24}$$

$$y = \frac{1}{EI}\left[\frac{wL}{12} x^3 - \frac{w}{24} x^4 - \frac{wL^3}{24} x\right]$$

2 Moment area method :-

$$\frac{1}{R} = \frac{M}{EI}$$



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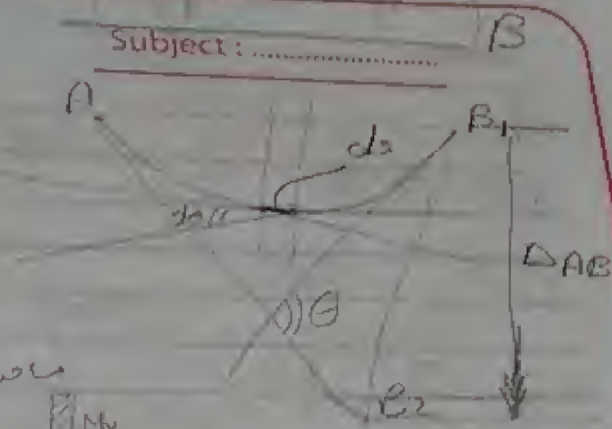
$ds \simeq dx$

Subject : ....



$$dx = ds = R\,d\theta$$

$$\frac{1}{R} = \frac{d\theta}{dx}$$

$$\frac{d\theta}{dx} = \frac{M}{E \cdot I}$$

$$d\theta = \frac{M \cdot dx}{EI} \longrightarrow \text{مساحة العزم}$$

$$\int d\theta = \int \frac{1}{EI} \cdot M\,dx$$

$$\int_A^B d\theta = \frac{1}{E \cdot I} \int_A^B M\,dx \longrightarrow ①$$

$$x\,d\theta = \frac{M x\,dx}{EI}$$

$$\int_A^B x\,d\theta = \frac{1}{EI} \int_A^B M x\,dx = \Delta_{AB}$$

مماس ٢ نقطتين A

$A \longrightarrow$ [illegible] $\qquad B \longrightarrow$ ✓

$A \longrightarrow$ elastic line [illegible] $\qquad B_1 \longrightarrow$ ✓

$B_2 \longrightarrow$ [illegible] $\qquad B_1 \longrightarrow$ ✓

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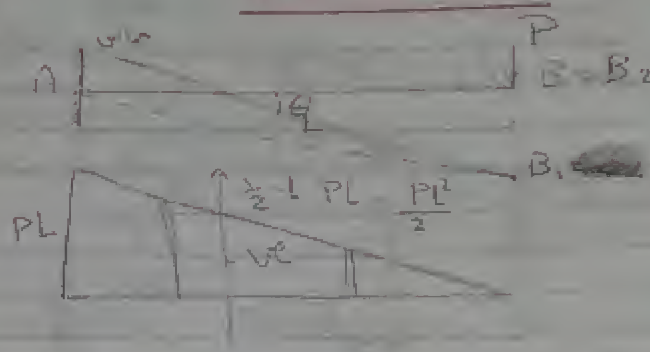
Ex



bet A, B

$B_1B_2 = BB_1$

$= \frac{1}{EI}\,\frac{PL^2}{2}\cdot\frac{2}{3}L$

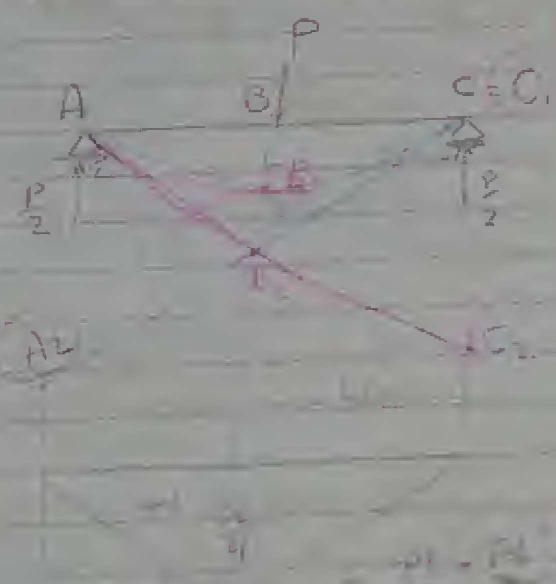
$= \frac{PL^3}{3EI}$

$\Delta L = k\,\frac{PL^3}{EI}$

ثابت

$\frac{1}{3}$

Ex



Between AC

$C_1C_2 = CC_2$

$C_1C_2 = CC_2 = \frac{1}{EI}\left[\frac{PL^3}{16}\right]$

bet A, B

$B_1B_2 = \frac{1}{EI}\left[\frac{PL^2\cdot L}{16\cdot 3}\right]$

$y_B = BB_2 - B_1B_2$

$BB_2 / CC_2 = \frac{L}{2} / L$

$\therefore BB_2 = \frac{1}{2}CC_2 = \frac{PL^3}{32EI}$

$\therefore y_B = \frac{PL^3}{32EI} - \frac{PL^3}{96EI} = \frac{PL^3}{48EI}$

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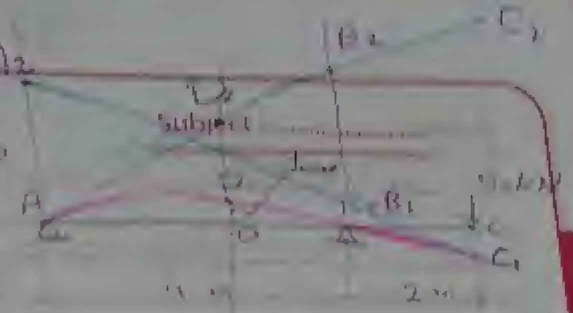
Req — Deflection at C ?

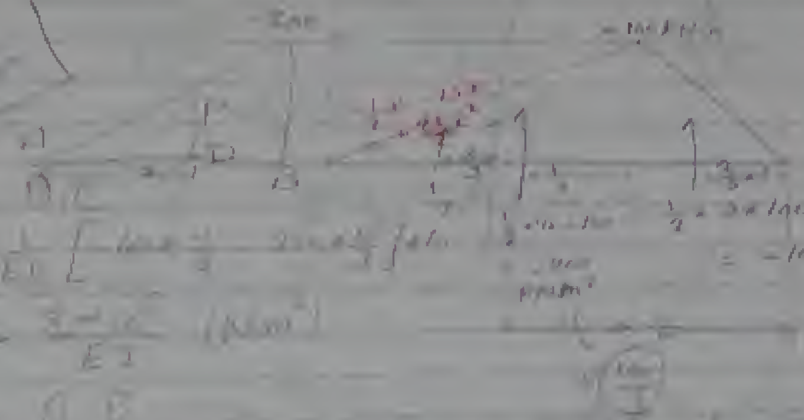
$E = 200\ GPa$

$I = 4 \times 10^{8}\ mm^4$

max deflection b/w A, B ?



Uhil



Between B, C

$$C_1C_2 = \frac{1}{EI}\left[-100 \times \frac{2}{2} \cdot \frac{2 \times 2}{3} \right] \times 10^{?}$$

$$= -\frac{8 \times 10^{?}}{EI}\ (N\,m^3)$$

Between A, B

$$B_1B_2 = AB_2 = \frac{1}{EI}\left[-200 \times \frac{4}{3} \right] \times 10^{3} = \frac{8 \times 10^{5}}{3EI}\ (N\,m^3)$$

$$\frac{y}{C} = CC_2 - C_1C_2$$

$$\frac{BB_1}{CC_1} = \frac{4}{6} = \frac{2}{3}$$

$$CC_1 = \frac{3}{2} BB_1 = \frac{4 \times 10^{5}}{EI}$$

$$\Delta_C = \frac{4 \times 10^{5}}{EI} = -5\ mm$$

$$\frac{P}{x} = \frac{-100}{4} \qquad P = -25x$$

b/w A, D

$$D_1D_2 = -\frac{1}{2} \cdot 25x^2 \cdot \frac{x}{3} \cdot \frac{1}{EI}$$

$$= \frac{25 \times 10^{3} \cdot x^{3}}{3EI}$$

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$$y_D : DD_1 = DD_2 - D_1 D_2$$

$$= \frac{-2 \times 10^{5}}{3EI} \cdot x + \frac{25 \cdot \times 10^{3} \times x^{3}}{6EI} \rightarrow (1)$$

$$\frac{dy}{dx} = 0 = \frac{-2 \times 10^{5}}{3EI} + \frac{3 \times 25\, x^{2} \times 10^{5}}{6EI}$$

$$-\frac{200}{3} + \frac{25 x^{2}}{2} = 0$$

$$\therefore \quad x = \sqrt{\frac{16}{3}} = 2.31\ m$$

y_D @ $x = 2.31$ [illegible]

$$y_D = y_{max} = 1.28\ mm$$